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Government Intervention in Agriculture

A Regulatory Approach

David W. Skully

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Abstract

This study examines the behavior of public agents creating and administering policies to transfer rent among domestic economic interest groups. After a brief survey of endogenous tariff theory and attempts to apply it to agricultural policy, the study develops a model synthesizing the economic theory of regulation and the theory of optimal taxation to generate hypotheses regarding the relation between economic development and the bias of agricultural and food policy. The analysis sustains the proposition that the bias of agricultural policy shifts from pro-consumer to pro-producer and from fiscal surplus to fiscal deficit with the industrialization and diversification of the national economy. The model also provides predictions of the onset of agricultural protectionism in middle-income countries.

Keywords: Regulation, agricultural policy, government intervention, producer subsidy equivalents, economic development.

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Contents

Introduction.. 1

Traditional and Endogenous Tariff Theories............. 2

The Economic Theory of Regulation...................... 4

Optimal Taxation in a Regulatory Model................. 7

Development and Agricultural Policy Bias............... 10
The Budgetary Transformation........................ 10
The Commercial Transformation...................... 11
The Urban Transformation........................... 12

Data and Methods....................................... 13

Results and Analysis................................... 17

When Do Countries Start to Protect Agriculture?........ 24

Conclusions.. 26

References... 27

Appendix: Observations Used in Study................... 32

Government Intervention in Agriculture

A Regulatory Approach

David W. Skully

Introduction

> [T]he relevance of the traditional theory [of tariffs] to the problems of economic policy depends on a particular assumption about the nature of government, namely, that government seeks to maximize real income but is ill informed about how to do this. ... [I]f, on the other hand, government is regarded as an extra-market system for modifying the distribution of income and wealth, interest would focus on the tariff structure as measuring the political power of various claimants to the national income.
>
> The theory presented [in this paper] is derived from the assumption of a "preference for industrial production"; by extension, agricultural protectionism can be explained by an assumed "preference for agricultural production." Since industrial protectionism is a major common policy of less developed countries (which are predominantly agricultural in economic structure) and agricultural protectionism is a major common policy of advanced countries (which are predominantly industrial in economic structure), the two preferences could be synthesized in the concept of a "preference for economic balance." ... Such a concept has the appeal of formal elegance and symmetry in explaining the commercial policies of countries at all stages of development.[1]

The quotation from Johnson (1965) introduces both the subject of this paper--the symmetry of the commercial policies of developed and developing countries--as well as its method: government intervention is modeled as a political artifact reflecting the "political power of various claimants to the national income." The objective of the paper is to apply the economic theory of regulation to explain the difference in the bias of government policy toward agriculture between developed and developing countries.

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[1]Johnson (1965:256 and 258).

Traditional and Endogenous Tariff Theories

Traditional tariff theory embodies two implicit assumptions. The first is that a government attempts to maximize some national income or national welfare function in the construction of its commercial policy. Second, tariffs are implicitly assumed to pertain only to commodities for final demand; this allows the full effect of a tariff on domestic markets to be deduced from the tariff rate, or nominal rate of protection (NRP). Stolper and Samuelson (1941) established this research program. Their theorem demonstrated how protection changes the distribution of income among productive factors. The articles which followed analyzed various special cases of the Stolper-Samuelson theorem.[2] In the 1960's the limitations of these implicit assumptions prompted several theoretical innovations. Corden (1966) is generally credited with extending tariff theory to include trade in intermediate products, or inputs, and developing the effective rate of protection (ERP) measure.[3] Considerable empirical work in the 1960's was devoted to the calculation of NRP's and ERP's for various countries, commodities, and resources, particularly as these concepts gained practical value in international trade negotiations.

As the Johnson (1965) quotation indicates, economists in the mid-1960's were beginning to re-examine the assumption that commercial policy was designed to maximize some form of national income or social welfare. Indeed, the mounting empirical evidence of patterns in ERP's and NRP's begged for explanation. The Stolper-Samuelson theorem reveals that tariffs are a way for governments to redistribute income among economic groups. Tullock (1967) cast the theorem in a new light by demonstrating that tariffs are property rights to a stream of rents much like Treasury bonds, and arguing that tariffs are granted to the highest bidders. Bidding can take place in a public auction, the proceeds becoming public revenue, or bidding can be effected by lobbying and in-kind payments to individual government officials. While tariffs produce allocative inefficiency, governments or individuals in public office may be willing to trade inefficiency for higher incomes. A government's incentive to create tariffs would be driven, as Johnson phrases it, by the "political power of various claimants to the national income." It took several years for Tullock's insight to influence the international trade literature; Krueger (1974) is an early empirical application.[4]

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[2]Bhagwati's (1959) retrospective presents a typology of this research.

[3]The ERP, while a theoretical improvement on the NRP, requires a matrix of fixed input-output coefficients, which, in reality, are rarely fixed, and render the ERP only as accurate as the input-output matrix.

[4]Tullock's contribution is the foundation for all subsequent "rent-seeking" work; the economic loss from bidding on tariffs must be added to the deadweight losses from the allocative efficiencies they create through relative price distortions.

By the early 1980's, a significant program of research seeking to identify the factors influencing a government's choice of tariff structure had emerged. "Endogenous tariff theory," as this research program has come to be known, encompasses several competing models and specifications; however, each explicitly focuses on explaining the behavior of public agents' choice of tariff regime.[5]

Research in agricultural trade policy has lagged the international economics literature by a few years, but it has followed a similar trajectory. Most contemporary research on agricultural policy, like traditional tariff theory, assumes that public agents are exogenous to the analysis. Policymakers are generally assumed to maximize farm income, maximize agricultural export revenue or volume, minimize domestic price volatility, or any of a number of "agricultural welfare" objectives.

Following the empirical tariff literature of the 1960's, agricultural economists in the late 1970's began to calculate NRP's or "price-gaps" for major commodities in major trading countries; Peterson (1978), Lutz and Scandizzo (1980), Bale and Lutz (1981), and World Bank (1983) are important contributions to this effort. The inclusion of agricultural commodities in the Uruguay Round of GATT, which commenced in 1986, has stimulated a second generation of empirical studies of government intervention in agriculture.[6] Several studies have analyzed the trade and distributional effects of the removal or reduction of agricultural protection; however, such studies implicitly assume an exogenous public sector free from political constraints.[7]

The first significant empirical work on endogenous agricultural trade policy dates from 1986 with the work of Honma and Hayami who employ the approach of Ray (1981) and Ray and Marvel (1984) to explain variations in the NRP's for agricultural commodities in most OECD countries (1986b) and in Taiwan and South Korea (1986a). Balisacan and Roumasset (1987) is similar in methodology to Honma and Hayami's work and examines the NRP's for an aggregate of four major grains among 68 market economies. All three papers reveal that significant variations in agricultural protection, like variations in industrial protection, can be explained by variables measuring aspects of a country's comparative advantage and level of income. One limitation of these studies is that the NRP captures only part of the effect of government intervention in agricultural markets. Direct payments, legally sanctioned cartelization via cooperatives,

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[5]Nelson (1988) provides a broad survey of endogenous tariff theory, drawing on the literature of economics and political science. Baldwin (1984) introduces and critically surveys competing endogenous tariff models.

[6]OECD (1987) and USDA (1988a, 1988b, 1989) are the key studies; their use of "subsidy equivalents" instead of NRP's and ERP's is discussed below in the data section.

[7]For example, Valdéz and Zietz (1980), Tyers and Anderson (1985), and Krueger, Schiff, and Valdés (1988).

production quotas, and "marketing orders" are among the other forms of publicly created transfers to agricultural producers.

Gardner (1983, 1987) addresses these "nonborder" aspects of government intervention in agriculture, and has initiated a strand of research which follows from Becker (1983). The essence of Becker's argument is that competition in the political market should result in the survivorship of relatively efficient means of income and wealth redistribution. For any given level of transfer, the policy set which effects this transfer with the least (deadweight) loss will ultimately dominate other policies. Gardner (1983) provides a theoretical exposition of this proposition with respect to U.S. agricultural policies. By developing the "surplus transformation frontier" between producers and consumers, Gardner demonstrates that, as in earlier works in welfare economics,[8] elasticities determine the incidence of deadweight loss. Gardner's (1987) paper empirically tests the proposition linking elasticities and the form and degree of U.S. Government intervention in agriculture. To account for both the influence of the political market in determining the distribution of transfers as well as the efficiency of the policies employed to effect transfers, Gardner uses both elasticities and a number of political-economic proxies. Among the latter are the number of producers, the concentration index of the commodity, lagged farm income, lagged relative prices, and the share of the commodity exported. The estimated coefficients are generally of the hypothesized sign and significant. While this is a significant contribution, the variety of political-economic proxies and the sensitivity of the model to the elasticities employed makes the analysis a little ad hoc.

The present study is a contribution to the endogenous agricultural policy research program and bears the influence of both Honma and Hayami, and Gardner. Among the objectives of this study are to reconfirm and explain the systemic difference between the food and agricultural policies of developed and less-developed nations; to present a parsimonious alternative to existing models; and to identify the conditions under which countries are likely to adopt protectionist agricultural policies. The present effort also employs a different and more inclusive measure of government intervention in agriculture than earlier studies, the subsidy equivalent, and examines the distributional effects on agricultural producers as well as food consumers and the general taxbase. The theoretical framework employed builds on the work of Peltzman (1976) and the public economics literature on optimal taxation.

The Economic Theory of Regulation

The economic theory of regulation developed from attempts to explain the effects, bias, and intent of government regulation of industry. The regulation of public utilities in the United

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[8]For example, Bator (1957).

States is the empirical focus of many early studies. In the 1970's, however, the theory was generalized and its empirical applications now range far beyond public utilities.

The contemporary economic theory of regulation commences with insights provided by Stigler (1971) and is formally presented in Peltzman (1976). "What Stigler accomplished in his 'Theory of Economic Regulation,' was to crystallize a revisionism in the economic analysis of regulation that he had helped launch in his and Claire Friedland's work on electrical utilities."[9] Prior to Stigler and Friedland (1962), a public interest, consumer-protection view of public regulation pervaded the economics profession. Stigler and Friedland compared pre- and post-regulation utility rates and stock prices to see if public utility regulation effected the supposed pro-consumer bias. Their findings revealed that regulation had little effect on prices or stock returns and they concluded that the consumer-protection theory could not be sustained. In the wake of this finding, a producer-protection or capture theory of public regulation developed. In essence, it argued that producers were better able to control public utility boards than consumers; the boards, therefore, were captives of producer interest groups and set rates in their favor.[10]

The empirical evidence, Stigler (1971) argues, suggests that regulation is rarely a corner solution; rather, "The political process, like the economic process, finds intermediate positions which reflect the equilibrium of diverse forces."[11] Peltzman (1976) expanded and refined Stigler's insights and translated these assumptions into constrained optimization form, making the decision calculus of public regulators subject to the same marginal conditions as any other agent in microeconomic analysis.

The Peltzman theory is essentially a model of the market for government intervention in the economy. Politicians, specifically public regulatory agents, behave as if they were brokers, clearing the market by allocating direct and indirect transfer payments among high and low bidders in the political market place.

All agents, public and private, are imputed rational utility-maximizing behavior. For an electrical utility, the rate schedule and restrictions on its rate of return and dividends/retained earnings distributions approved by the regulatory agents are arguments in the indirect utility functions of management and labor, bond and shareholders, industrial and household consumers of power, as well as the regulatory agents themselves. Each individual in each group decides whether and

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[9]Peltzman (1976:211).

[10]Jordan (1972) is a good survey of the capture theory. Kolko's (1963, 1965) contributions on the history of the progressive era were also influential in the formulation of the capture theory.

[11]Stigler (1975:138).

how much to lobby the regulatory body to bias rates in his favor. The regulators similarly are assumed to behave as if they maximized the security of their tenure, by approving rate schedules which gain them the most political support.

Given these universally applied behavioral axioms, the theory identifies the determinants of effective political demand. Building on the contributions of Downs' (1957) notion of rational ignorance and similar contributions by Buchanan and Tullock (1962), Olson's (1965) work on the logic of collective action, as well as Stigler's (1964) work on the theory of oligopoly, the economic theory of regulation is "ultimately a theory of the optimum size of effective political coalitions."[12] In its simplest form, the theory posits that regulators wish to maximize their political support Ω:

$$\Omega = n * f\left(\frac{T(1-\phi)-C(n)}{n}\right) + (N - n) * g\left(\frac{T(1+\sigma)+C(N-n)}{N - n}\right) \qquad [1]$$

Where:

Ω represents net political support for the incumbent,

N is the total population,

n is the size of the set of net beneficiaries of intervention,

N-n is the complementary sub-set, the tax base.

T represents the transfer from the tax base. This value may be composed of taxes paid, loss of consumer surplus, public services foregone, etc. T is best considered the equivalent variation of foregoing the transfer.

ϕ is the proportion of the transfer retained by the state; it includes, for example, rent-seeking and revenue absorption through administrative costs.

σ represents deadweight losses resulting from policies.

$C_i(.)$ represents organizational costs: $C_i > 0$ and $C_{ii} > 0$, which increase at an increasing rate with respect to group size, consistent with Olson (1965) and Buchanan and Tullock (1962).

$f(.)$ and $g(.)$
map the net per capita transfer value into the probability of support or opposition, respectively, of group members, with the following derivatives:

[12] Peltzman (1976:212).

$$
\begin{array}{llll}
f_T > 0 & f_{TT} < 0 & g_T > 0 & g_{TT} > 0 \\
f_\phi < 0 & f_{\phi\phi} > 0 & g_\sigma > 0 & g_{\sigma\sigma} > 0 \\
f_n < 0 & f_{nn} < 0 & g_{N-n} < 0 & g_{N-n,N-n} < 0 \\
f_C < 0 & & g_C < 0 &
\end{array}
$$

Support and opposition increase in T, but, following Bernoulli (1738), the declining marginal value of income causes the second derivatives to be negative and positive, respectively. Similarly, support decreases in ϕ at an increasing rate, and opposition increases at an increasing rate. Increases in group size dilute the per capita effect of the net group transfer, but at a decreasing rate. Finally, increasing organizational costs obviously inhibit effective political action.[13]

For a given level of transfer, the smaller the size of the beneficiary group (n), the larger its members' potential per capita gain. The prospect of a per capita transfer above some threshold will overcome the political inertia of potential beneficiaries and induce them into the "political market" to influence regulatory decisions. The potential opposition group is the tax base of the transfer (N-n); the larger the membership of the tax base, the smaller the per capita loss likely to be exacted. As long as the per capita tax is less than some threshold, political inertia is not likely to be overcome, taxed individuals will remain rationally ignorant,[14] and large-scale opposition is unlikely.

While not explicitly specified in this two-group example, the more homogeneous the composition of a group the easier the task of organization. Consequently, in this simple regulatory case as well as general fiscal decisions, governments will tend to target large heterogeneous groups as tax bases.

Optimal Taxation in a Regulatory Model

The Peltzman-Stigler model and the Ramsey optimal tax formulation are merged to yield testable propositions about the variations in the incidence of agricultural policy among countries and commodities. The optimal taxation problem was first formulated by Ramsey (1927) in response to a question raised by Pigou: given a revenue requirement, $R_o \le \Sigma_i t_i X_i$, what vector of taxes (t_i) on commodities (X_i) minimizes the welfare losses to the economy?[15] Ramsey set the problem in Lagrangean form, expressed here in

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[13]While there are undoubtedly economies of scale in organization, they are more than negated by free riding.

[14]"Rational ignorance" is the rational response of an individual to the cost of information about a particular public policy issue and to the cost of effecting a policy change once the information is acquired.

[15]This is essentially the efficiency solution that Becker (1983) and Gardner (1983) postulate and Gardner (1987) tests.

contemporary notation:[16]

$$£ = \Psi(\mathbf{V}(\mathbf{q})) + \lambda(\Sigma_i^z t_i(\Sigma_h^H X_i^h(\mathbf{q})) - R_o) \quad [2]$$

Where $\Psi(.)$ is the social welfare function, $\mathbf{V}(\mathbf{q})$ represents the h x 1 vector of indirect utility functions, $V^h(\mathbf{q},M^h)$, of h households; $\mathbf{q}$, a z x 1 vector of z commodity prices and taxes: $q_i = p_i + t_i$; and M^h, household income.[17] The Ramsey formulation was independently discovered by Boiteux (1951, 1956) in deriving the optimal (that is, deadweight loss minimizing) rate schedule for a publicly regulated firm with a profit constraint.[18]

Contemporary optimal taxation literature takes as given the proposition that public agents seek to maximize social welfare, however defined, and ritually employs a Bergson-Samuelson social welfare function (SWF) as the objective of the maximization problem. The economic theory of regulation, however, recognizes that public agents follow private agendas and that the actual objective of policy is an artifact of the political market. Consequently, for empirical analysis the Peltzman majority function ($\Omega(.)$) is a more plausible objective than a social welfare function. The Ramsey formulation may therefore be rewritten:

$$£ = \Omega(\mathbf{V}(\mathbf{q})) + \lambda(\Sigma_i^z t_i(\Sigma_h^H X_i^h(\mathbf{q})) - \pi_o) \quad [3]$$

As the present analysis is concerned with transfers between food consumers and agricultural producers, one can aggregate the private agents in the economy into two separable groups, h = 1 and 2. The first order conditions of the Lagrangean [3] are:

$$\partial\Omega/\partial V^h \ \partial V^h/\partial q_i + \lambda \ (t_i \ \partial X_i/\partial p_i + t_j \ \partial X_j/\partial p_i + X_i) = 0 \quad [4]$$

By assumption, the cross terms, $\partial X_j/\partial p_i$, equal zero. The term $\partial\Omega/\partial V^h \ \partial V^h/\partial q_i$ can be rewritten as $-\beta^h X_i$ by employing Roy's identity, $\partial V^h/\partial q_i = -\alpha^h X_i$, where α^h represents h's marginal utility of income, and letting $\beta^h = \partial\Omega/\partial V^h \ \alpha^h$. Substituting, rearranging, and writing the elasticity of demand for X_i, ε_i, as a positive value yields:

$$1 - \beta^h/\lambda = t_i/p_i * \varepsilon_i \quad [5]$$

The only distinction between the present solution and the Ramsey/Boiteux solution is the interpretation of the term β^h, but the distinction is fundamental. In the optimal literature, β^h is

---

[16]The contemporary treatment of optimal taxation and optimal public sector pricing emerged in the Ramsey renaissance of 1970-1972. See Diamond and Mirrlees (1971) and Baumol and Bradford (1970).

[17]Ramsey (1927) employs Marshallian demand curves; indirect utility functions are substituted for ease of exposition.

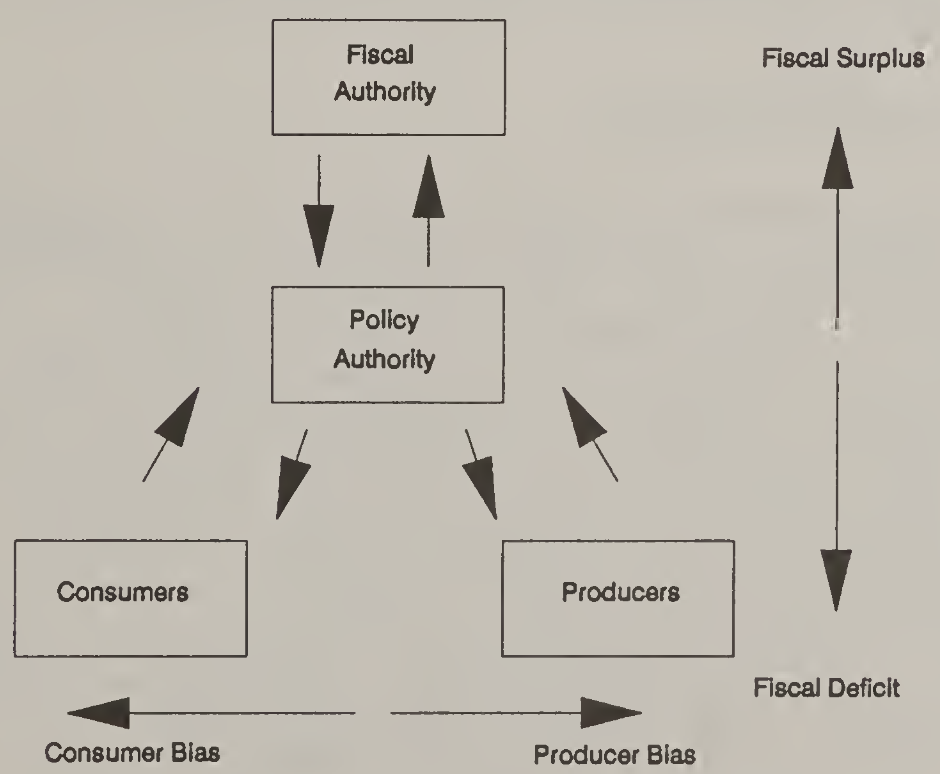
[18]One can merely replace the revenue constraint with a profit constraint (π_o) and define t_i as the price/marginal cost margin for X_i.

the marginal social value of sector h's income (via the SWF, $\Psi(.)$); in the present framework, β^h is the marginal (gain or loss of) political support for the regulator from sector h (via $\Omega(.)$). λ has essentially the same meaning in both contexts: it is the marginal (social or political) value of revenue to the regulator.

If the elasticities are held constant, the tax rate (t/p) is an indirect function of the ratio, β^h/λ. Clearly, the larger the value of β^h, the lower tax rate levied on sector h. When $\beta^h > \lambda$, the marginal (social or political) value of income to sector h is greater than the marginal (social or political) value of income to the regulator, this will result in a subsidy, a negative tax rate.[19] For the polar cases: the set of weights imposed by Leviathan would be $\beta^h = 0$, $\forall$ h (or alternatively $\lambda = \infty$) leading to the standard monopoly pricing solution; while a perfectly competitive firm faces $\beta^h = \lambda$, so t/p = 0 (that is, price equals marginal cost). Variations in the elasticity of demand are, as in the monopoly model, inversely related to the revenue-maximizing price or tax rate. Finally, if π_o, the budget constraint, is allowed to vary, then political support may be gained or lost by running a budget deficit or surplus. Running a deficit by giving higher prices to producers and/or lower prices to consumers increases political support for the incumbent. A surplus will cause political support to diminish.

Figure 1 is a diagrammatic representation of the political market for government intervention. Both consumers and producers

Figure 1
The Market for Government Intervention



[19]Peltzman (1976:231) "The substitution of political for economic criteria in the price formation process ... is at the heart of the pervasive tendency of regulation to engage in cross-subsidization."

attempt to increase (or prevent reductions in) their utility through political action. The public agents with discretion over agricultural policy attempt to balance marginal net political support and marginal revenue. Funds may be withdrawn from the surplus revenue from intervention or transferred from the fiscal authority to finance a deficit in intervention. The net transfer between producers and consumers is measured horizontally; policies are pro-consumer [$\Sigma\beta < 0$] or pro-producer [$\Sigma\beta > 0$] on this axis. The net transfer between the fiscal and the agricultural policy authorities is measured vertically; policies are fiscally surplus [$\lambda > 0$] or deficit [$\lambda < 0$].

The following section works through the comparative statics of the level of economic development on the arguments of the model in terms of the fiscal and interest group bias of agricultural policy.

Development and Agricultural Policy Bias

The metamorphoses of agricultural production, marketing, and food consumption in the course of economic development result in industrialized economies having interest group sizes and agricultural policies which are the virtual inverse of those of less-developed economies. While each country's path of development is unique, there are some universal patterns which help account for the differences one observes between food and agricultural policies in developed or industrial market economies (IME's) and those in developing or less-developed countries (LDC's). Three universal transformations--the budgetary transformation, commercialization, and urbanization--are discussed in turn to analyze their influence on the arguments of the majority function.

The Budgetary Transformation

The budgetary transformation was first noted formally by Engel (1857) whose insights have been repeatedly confirmed and refined.[20] Engel found that as a family's income increases, the proportion of its income spent on food declines. A very poor family may spend virtually all its resources to procure a ration of grains or tubers, while a rich family may eat large amounts of luxury foods and spend only a negligible proportion of its income on food. In the context of food and agricultural policy, policies which affect the consumer prices of basic food items will have a significantly greater impact on the welfare of lower income households than on richer households. In terms of the Peltzman model, a shift in household income is reflected in a shift in the support and opposition functions with respect to food price policies: the probability of support or opposition is greater the lower household income, and the larger the food share of household expenditure.

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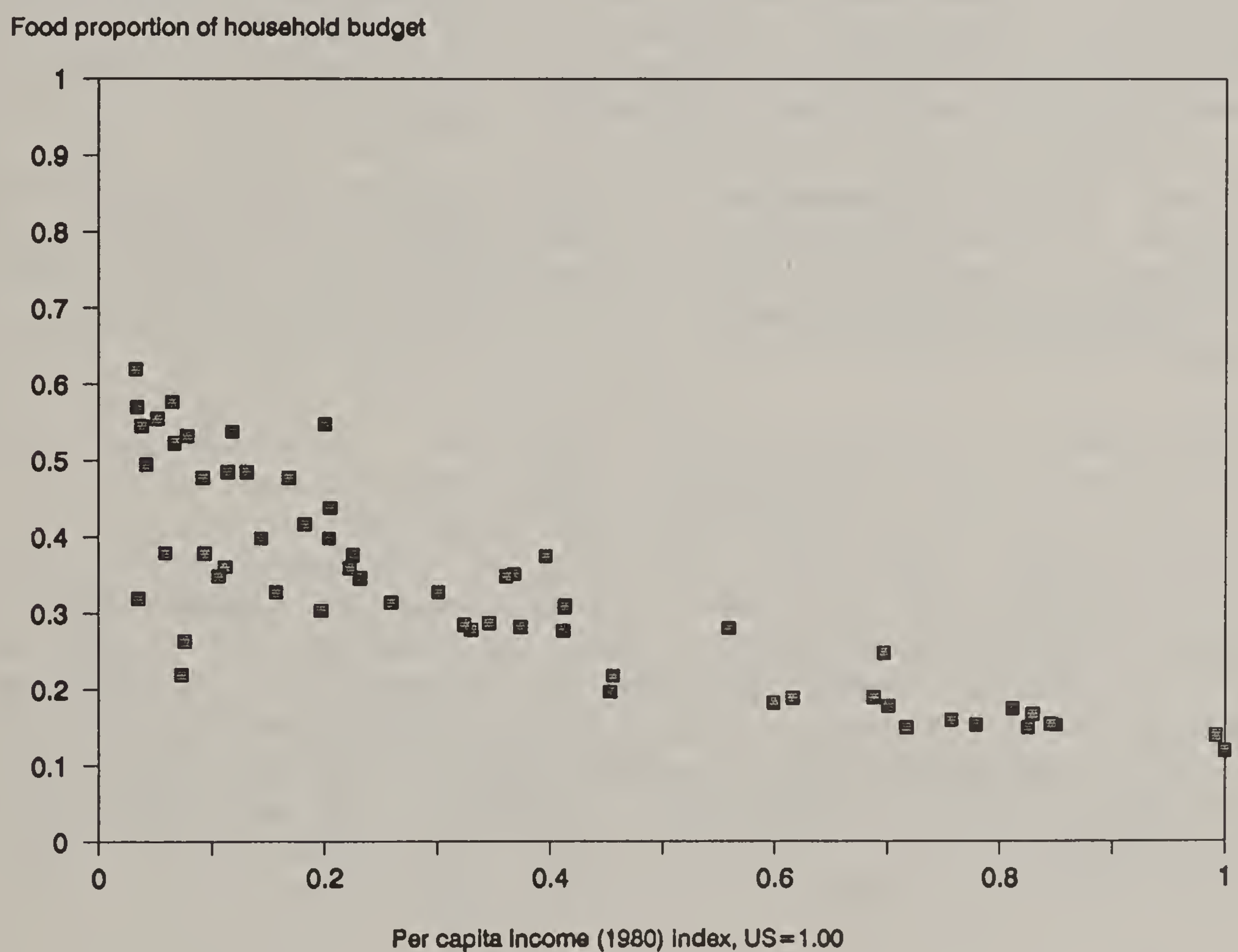
[20]For example, Allen and Bowley (1935), Houthakker (1957), Stone and Rowe (1954).

Figure 2 plots observations of food budget shares against per capita expenditure for 60 countries for 1980 (United Nations 1986-87). Per capita expenditure is adjusted following the method developed by Kravis, Heston, and Summers (1978) and normalized with U.S. expenditures equal to 1. There is considerable dispersion, but a clear downward-sloping relation is evident.[21] It follows that one expects consumers in LDC's to be more likely to voice support for lower food prices and opposition to higher food prices than consumers in IME's.

The Commercial Transformation

As the number of farmers declines relative to total population in the course of development, the remaining agricultural producers become much more specialized. LDC farm households tend to produce a wide portfolio of crops, primarily for household use, and market only a small proportion of total household output. Most IME producers specialize in one or two products and market virtually all of their output. Consequently, the producer price of an agricultural commodity will have a much greater effect on the income of IME producers than on LDC farmers. The relatively capital-intensive nature of agricultural production in developed

Figure 2
The Budgetary Transformation



[21]A simple linear regression yields:
FOOD BUDGET SHARE = .474   -.400   *   INCOME INDEX
t-stat: (-11.58)
$R^2 = .70$

countries also means that producers often have a large proportion of their net worth invested in assets specific to the production of a particular commodity, particularly in farmland and farm machinery (for example, wheat combines and dairy equipment). The value of these commodity-specific assets (and the producer's net worth) fluctuate with commodity prices and commodity price expectations. The combined income and wealth effects of changes in commodity prices provide a major incentive for agricultural producers in IME's to organize and effect some control over prices, either through private monopolies (cooperatives) or through government-enforced policies.[22]

In a pure microeconomic sense, the firm and household are merely two manifestations of a constrained maximization problem.[23] The budgetary data above reveal that the food budget share declines monotonically with income; commercialization of the rural sector results in a monotonic increase in the proportion of household production marketed (the marketed surplus).

The Urban Transformation

A third universal pattern of development is urbanization. In the least developed nations, most of the population lives in isolated rural areas and most of their labor is devoted to producing food and other essentials for their own use or for trade in a limited local market. Rural producers form a large, heterogeneous, and geographically dispersed tax base from which a surplus can be extracted at a relatively low per capita cost. Moreover, because it is difficult to organize opposition in the rural sector, taxes can be extracted without significant opposition.

In contrast, urban households in the poorest developing countries tend to form a relatively small, geographically compact group, with a large per capita stake in demanding low staple food prices. Organizational costs are significantly lower in towns than in the rural areas.

With development, internal trade expands. More people seek urban employment, and rural households begin to produce crops for trade for city-made or imported goods. In the latter stages of industrialization, the vast majority of the population is engaged in nonagricultural activities. In industrial economies, urban households comprise the bulk of the population, and the vast majority have only a small per capita interest in lobbying for lower staple food prices or lobbying to prevent higher food prices. Moreover, the large economically heterogeneous character of the nonagricultural population makes it an easy target for indirect taxation.

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[22] Skully (1988). See Mayhew (1972) and McGuire (1981) on the relation between commercialization and agrarian unrest in late-nineteenth century America.

[23] Becker (1965).

Farm households in IME's are relatively few in number and have a very large stake in obtaining higher prices or other forms of public subsidy. As Olson (1985) argues, organizational costs for the rural sector decline with development:

> In rural areas of low-income societies without dense, modern networks of transportation and communication,...sustained large-scale collective action is normally impossible. This is especially true if the society is politically unstable, as most developing societies are.
>
> As transportation, communication, and the levels of education improve and the political system becomes stable, the great difficulties of collective action will be overcome even in the rural areas. Thus farmers will be among the groups that are organized for collective action. Farmers in such societies will be among the beneficiaries of tariffs and government subsidies.[24]

With development, the proportion of net food-producing households in the population declines and, necessarily, the proportion of net food-consuming households increases. This shift in relative group sizes affects both the numerators and denominators of the arguments in the political support function. Organization and coordination costs fall with a falling group size, while per capita benefits increase for a constant transfer. The urban transformation alone drives government policy toward a producer bias in developed countries. When urbanization effects are combined with the effects of the budgetary and commercial transformations, the shift toward a producer bias is compounded. In terms of the model of the previous section, the β for consumers will decline with respect to development, the β for producers will increase with respect to development, and λ--measured as a budget surplus on agricultural intervention--will decrease with respect to development.[25]

Data and Methods

Because intervention in agriculture occurs through many different means--taxes, regulations, marketing boards, tariffs, quotas, marketing orders, allotments, subsidies, and provision of public goods--a broader measure than the nominal or effective rate of protection has been developed. The "subsidy equivalent" (SE) measure was devised by Josling[26] as a means toward making cross-country and cross-commodity comparisons of the incidence of government agricultural policies. All agriculture-specific

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[24] Olson (1985: 935-936, 936).

[25] Formally, $\partial(\Sigma\beta)/\partial NAGDP > 0$; $\partial\lambda/\partial NAGDP < 0$, where NAGDP is the nonagricultural proportion of gross domestic product, the proxy for development and structural change employed below.

[26] In FAO (1975).

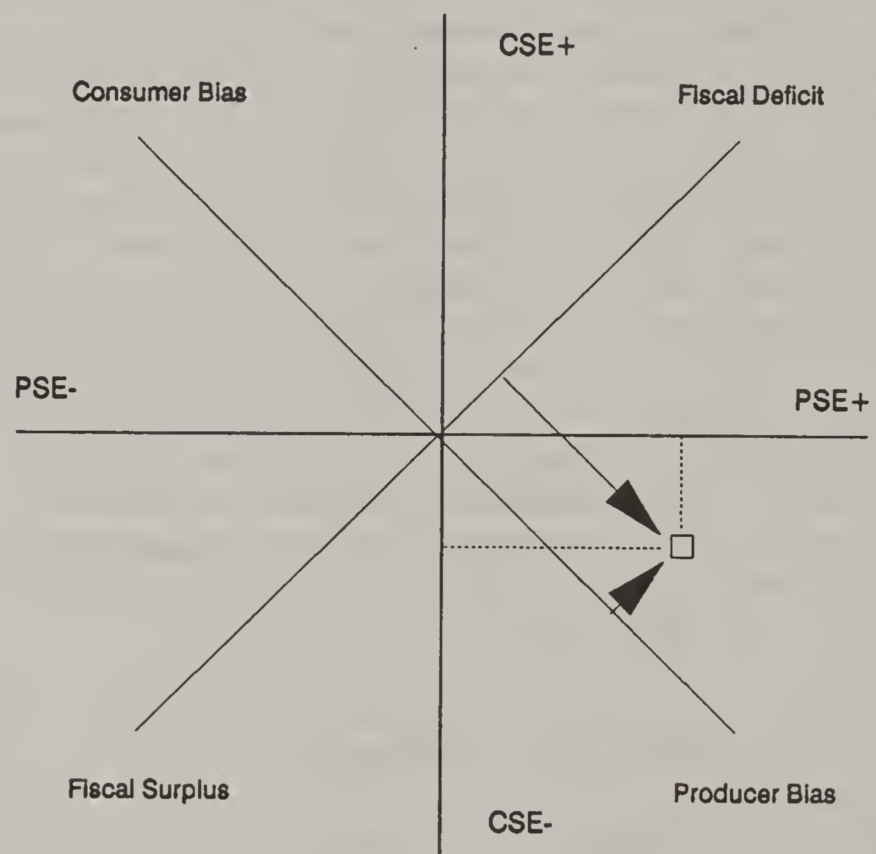
policies are converted into "subsidy equivalents," the lump sum cash payment that would leave producers or consumers indifferent between the subsidy or the existence of the intervention.[27]

When the SE for producers (consumers) of a commodity in a given year is divided by the total value produced (consumed) of the commodity, the result is called the percentage SE. The percentage SE is essentially a measure of the sum of direct, indirect, and in-kind tax rate (if negative) or subsidy rate (if positive) on the consumers or producers of a commodity. Producer and consumer subsidy equivalent (PSE and CSE) henceforth refer to their percentage measures.

SE's may be employed as indicators of revealed political weights. Figure 3 plots a Cartesian product (PSE, CSE) for a single commodity; if the quantity produced equals the quantity consumed, the set of tax (SE) rates which balance the budget for a given

Figure 3

Transformation of Data



[27]Subsidy equivalents are viewed skeptically by many economists, including the author, as there is no clear theoretical rationale which yields rules to determine their scope and estimation or calculation. The ERP is clearly preferred on theoretical grounds; however, because the ERP is only as good as the coefficients in the activity matrix, ERP calculations may contain considerable measurement error. The SE, unlike the ERP, can include the value of public goods and direct transfer payments both of which are important policy instruments of intervention in agriculture. See Schwartz and Parker (1988) for a discussion of the differences among SE's, NRP's and ERP's and their value in agricultural trade negotiations.

commodity program is CSE = -PSE, that is, a line through the origin with the slope -1. The budget deficit or surplus for any pair of rates is measured by the length of the perpendicular to the balanced budget diagonal. The set of tax rates which reveal equal political weights is PSE = CSE, that is, a line through the origin with the slope +1. The net political bias for any set of taxes ($\Sigma ßi = ßp+ßc$) can be measured by the length of the perpendicular to the zero bias diagonal.

The Cartesian product ($\Sigma ßi,\lambda$) is determined by rotating the axis of the (PSE, CSE) coordinate system by, in this case, $\theta = -45°$. The degree of rotation varies with the ratio of production to consumption: if production exceeds consumption, then a higher tax rate must be levied on consumers than on producers if accounts are to balance. The angle of rotation is the cotangent of the slope of the balanced budget axis, as measured in (PSE, CSE) space: $\theta = \tan^{-1}(-Pq/Cq)$.[28] The same (PSE, CSE) value will have a different ($\Sigma ß,\lambda$) value as θ varies.

Figures 4 and 5 plot the (PSE, CSE) and ($\Sigma ß$, λ) values, respectively, for 133 commodity-country observations. The observations are represented by four country groupings: OECD member countries (essentially IME's), LDC's, CPE's (centrally planned economies: China, Poland, USSR and Yugoslavia), and TSK (Taiwan and South Korea).

SE's calculated for centrally planned economies are probably subject to a measurement bias. In centrally planned economies, public agents are induced to set consumer prices below market-clearing levels. The excess demand which results is resolved in two adjunct markets: queues, in which consumers pay in terms of the length of time they wait for the good to be sold at the official price, and bribes, in which consumers purchase the right to buy the good at the official price from the public agents who control supply and distribution. Private sales of "purchase rights" by public agents are black market transactions which are neither officially observed in the home country, nor included in the SE calculations. The rent captured by public agents in the "purchase rights" market results in the appearance of consumer subsidies financed at a loss to the central government. In terms of the present analysis, the consumer ß will appear to be greater than the producer ß, relative to other nations of similar income levels, and the deficits λ will be larger than in countries of similar income. A dummy variable is included to account and test for the CPE effect.

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[28] $\Sigma ßi = PSE * \cos\theta + CSE * \sin\theta$;
$\lambda = CSE * \cos\theta - PSE * \sin\theta$.

Figure 4

Consumer and Producer Taxes and Subsidies

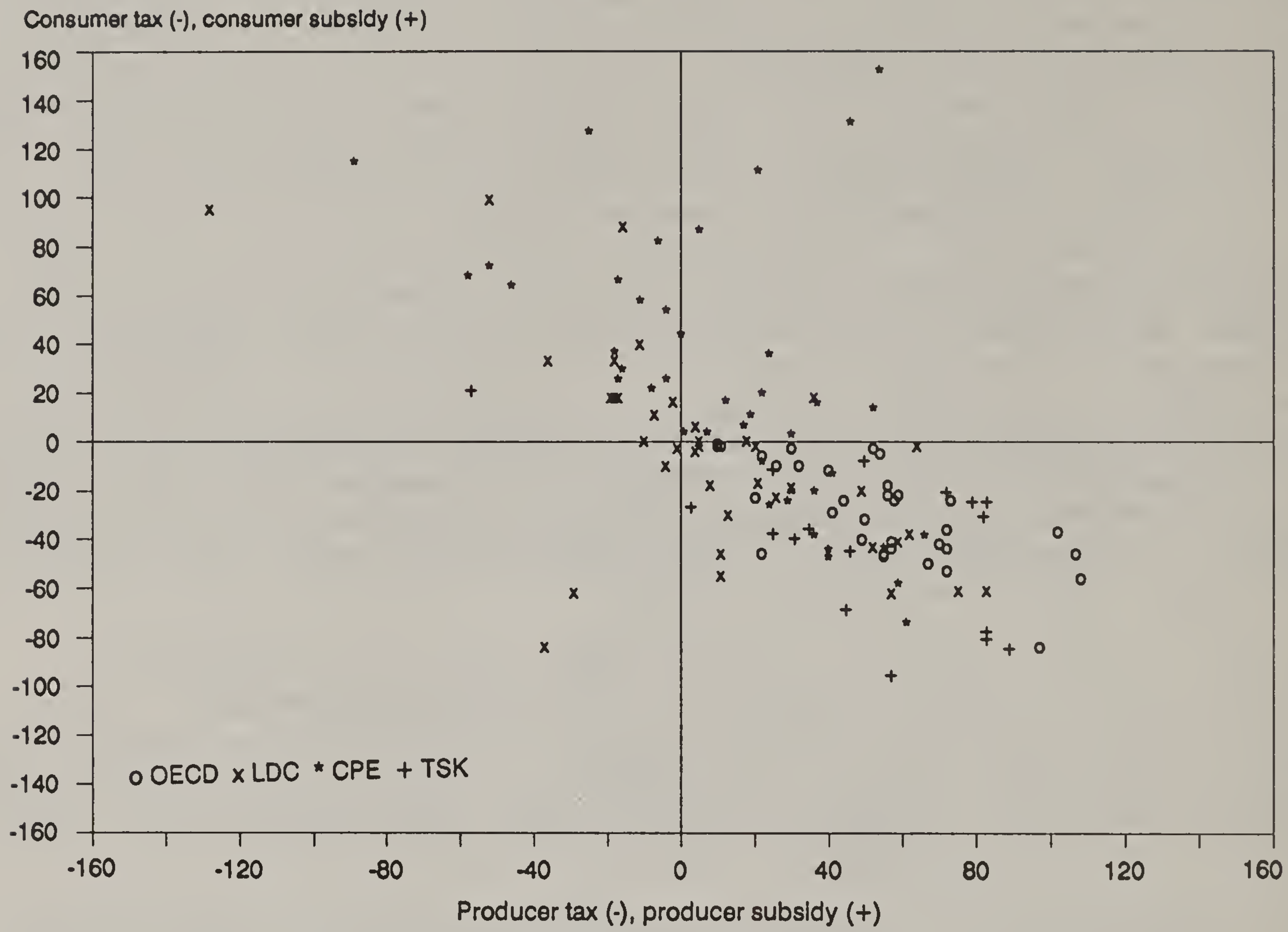
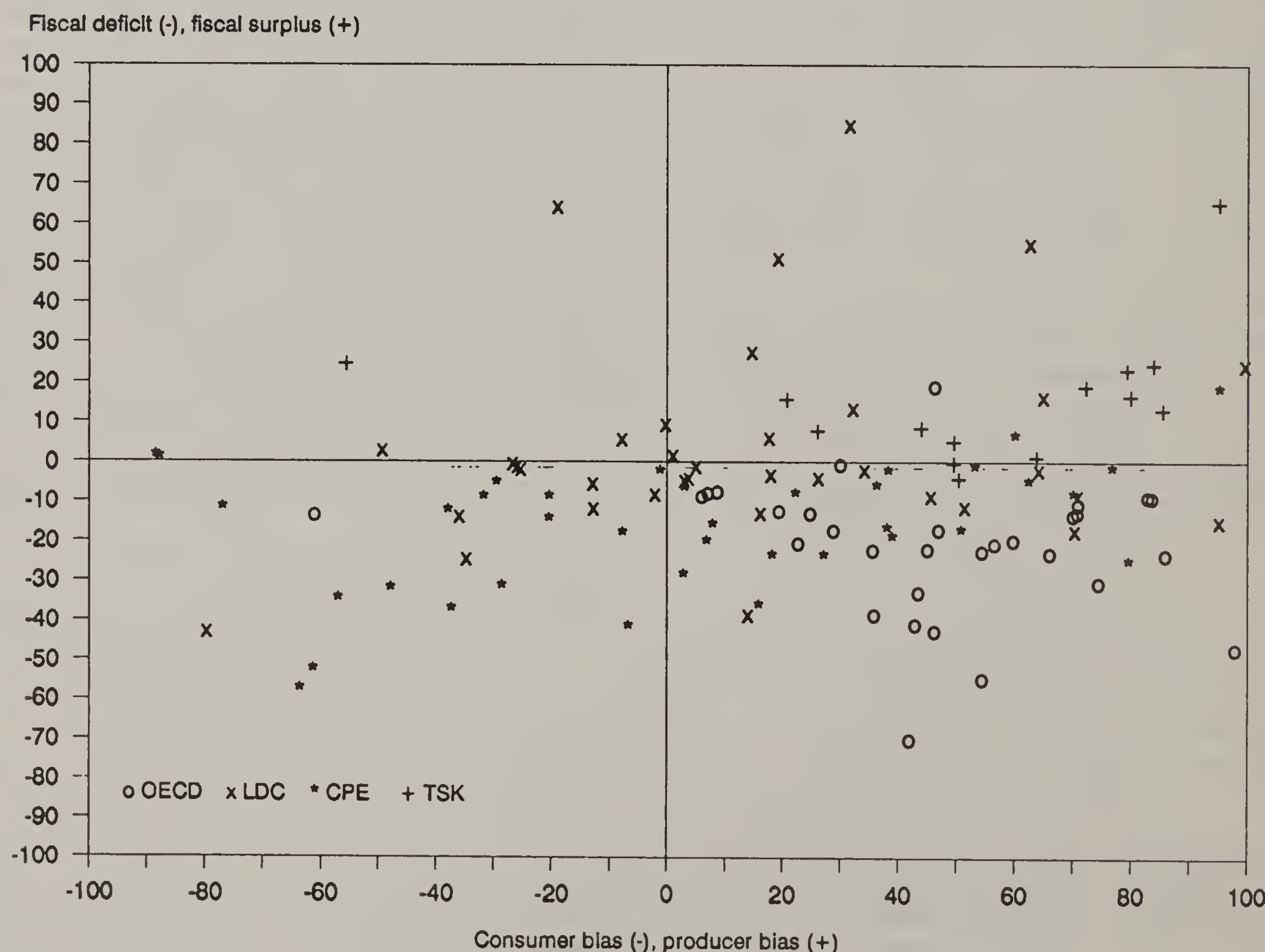


Figure 5

Fiscal and Interest Group Biases



Results and Analysis

Two equations with identical specifications were employed to test the propositions deduced in the previous sections (hypothesized signs are shown in parentheses below variables):

$$(\Sigma \beta)_{ij} = \delta_{10} + \underset{(+)}{\delta_{11}\ NAGDP_i} + \underset{(-)}{\delta_{12}\ CPE} + \delta_{1j}\ COMMODITY_j + e \qquad [6]$$

$$\lambda_{ij} = \delta_{20} + \underset{(-)}{\delta_{21}\ NAGDP_i} + \underset{(-)}{\delta_{22}\ CPE} + \delta_{2j}\ COMMODITY_j + e \qquad [7]$$

Where

$(\Sigma\beta)_{ij}$	The net policy bias for commodity j in country i; $\Sigma\beta > 0$ indicates a pro-producer bias, $\Sigma\beta < 0$ indicates a pro-consumer bias.
λ_{ij}	The fiscal balance of commodity j in country i; $\lambda > 0$ indicates a budget surplus, $\lambda < 0$ indicates a budget deficit.
δ	Coefficient symbol;
$NAGDP_i$	Nonagricultural proportion of gross domestic product of country i;
CPE	Centrally planned economy dummy;
$COMMODITY_j$	Dummy variables for commodity groups
e	Error term.

NAGDP was selected as the superior indicator of development in terms of the present model. NAGDP is available for all countries in the sample, and is highly correlated with (a) the budget share allocated to food and agricultural products (and, indirectly, the elasticity of demand); (b) the agricultural proportion of the labor force; and (c) economic development and the integration of the domestic market.[29] Dummy variables for the following commodity groups were included: food grains (wheat, rice), feed grains (corn, sorghum, oats, barley), sugar, milk (both fluid and manufacturing), and livestock (beef, veal, pork, poultry). Commodities not categorized include honey, cotton, eggs, mutton, oilseeds, and dried beans.[30]

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[29] World Bank (1986) and USDA-ERS (1990) for CPE nations. The model calls for supply and demand elasticities; there is, however, no consistent set of elasticity estimates for the country-commodity combinations used in the present sample. What the present analysis loses by excluding elasticities it gains in avoiding the biases introduced by including inappropriate or heterogenous estimates of elasticities.

[30] Mutton is not considered livestock in this specification, because sheep are rarely placed on feed rations.

Some propositions about the relative magnitudes of the commodity dummy variables follow from the model. With regard to political bias: the commodity groups which are produced primarily for direct household demand--wheat, rice, milk, sugar, and livestock products--are the most likely to catalyze consumer opposition if prices are viewed as either high or volatile. (1) The consumer weight (β_c) on these commodities is greater than on feed grains; consequently, the coefficients of the former should be lower than the latter. (2) A corollary of this ranking of political weights is that the ranking of fiscal coefficients should be just the opposite. The budgetary costs of food grain and milk intervention should be greater than the cost of feed grain intervention. (3) A high producer bias for feed grains constitutes an indirect tax on consumers of feed grains; hence, the fiscal coefficient on livestock should be relatively low, as it is unlikely that livestock producers can exert the political power to gain compensation for the effect of the feed grain tax as well as additional transfers to bring them to parity with other commodity groups.[31] (4) The indirect tax on livestock may also reveal that its political coefficient is less than those for food grains and milk. (5) Sugar is more of a tradable commodity than the other commodities studied: it is an important developing country export and an important developed country import. The instruments of rent creation and transfer in sugar are more likely to involve border measures than domestic measures, such as export taxes and import duties. Consequently, intervention in sugar is more likely to generate a fiscal surplus than intervention in the other commodity groups.

Combined, these propositions yield the following rankings for the coefficients of the commodity dummy variables. Recall that a higher political bias means a more pro-producer bias:

Political bias:

$$\delta_{\text{FEED GRAINS}} > \delta_{\text{SUGAR}},\ \delta_{\text{FOOD GRAINS}} \ \&\ \delta_{\text{MILK}} \geq 0 \geq \delta_{\text{LIVESTOCK}}$$

Fiscal bias:

$$0 \geq \delta_{\text{SUGAR}} \ \&\ \delta_{\text{LIVESTOCK}} > \delta_{\text{FEED GRAINS}} > \delta_{\text{FOOD GRAINS}},\ \delta_{\text{MILK}}$$

The coefficient on uncategorized commodities equals zero.

The ordinary least squares method was employed to estimate the coefficients. The regression results are in tables 1 and 2. The signs of the coefficients for the economic structure variables (NAGDP and CPE) are significant and of the expected signs. The signs and magnitudes of the commodity coefficients are of the expected signs and, with one major exception, their relative magnitudes conform to the order hypothesized above. That several of the coefficients are not significantly different

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[31]Livestock producers are often integrated upstream with feed production; this is particularly true for farm households in developing countries.

from zero at even the 0.2 level (the FOOD GRAINS, MILK, and LIVESTOCK variables in the $\Sigma\beta$ equations) is also consistent with the hypothesized ordering. The primary unexpected result is the large pro-producer bias estimated for sugar. This may be the result of the large-scale nature of most sugarcane production and the political influence of plantation-owning elites in the developing countries in the sample.

The R^2's of the regressions, while low in absolute terms (0.29 and 0.21, and 0.33 and 0.24), are not unusual for cross-sectional analysis. The R^2's of the $\Sigma\beta$ and the λ reduced-form equations are not the best measures of the goodness of fit of the model. $\Sigma\beta_{ij}$ and λ_{ij} are functions of PSE_{ij}, CSE_{ij}, and θ_{ij}:

$$\Sigma\beta_{ij} = PSE_{ij} * \cos \theta_{ij} + CSE_{ij} * \sin \theta_{ij}; \qquad [8]$$

$$\lambda_{ij} = CSE_{ij} * \cos \theta_{ij} - PSE_{ij} * \sin \theta_{ij}. \qquad [9]$$

A more appropriate measure of the goodness of fit of the model can be calculated by substituting the estimated values of $\Sigma\beta_{ij}$ and λ_{ij} in to Eqs. [8] and [9] and solving for ˆPSE and ˆCSE yields, via Cramer's rule:

$$\hat{}PSE_{ij} = (\hat{}\beta_{ij}*\cos\theta_{ij} - \lambda_{ij}*\sin\theta_{ij}) / (\cos\theta_{ij}^{2} + \sin\theta_{ij}^{2}) \qquad [10]$$

$$\hat{}CSE_{ij} = (\hat{}\lambda_{ij}*\cos\theta_{ij} - \beta_{ij}*\sin\theta_{ij}) / (\cos\theta_{ij}^{2} + \sin\theta_{ij}^{2}) \qquad [11]$$

ˆPSE and ˆCSE, the fitted values of PSE and CSE, can be used to calculate R^2 measures for PSE and CSE, independently, and jointly for the Cartesian product (PSE, CSE). These estimates may be contrasted with a simple regression of untransformed SE's on income and commodity information; the simple regression results are in tables 3 and 4. Goodness of fit measures for the expanded model and those for "simple" equations are shown in table 5.

The model results are clearly superior to the simple specification. One characteristic common to all specifications is that the goodness of fit for PSE's is far superior to the fit for CSE's. This difference may result from the process by which SE's are calculated. The impetus of the SE measurement has been agricultural trade liberalization and emphasis has been on transfers to agricultural producers rather than on transfers to or from consumers; consequently, the PSE is probably a more inclusive and accurate metric of intersectoral transfers than is the CSE. For the PSE, the regression results provide some empirical support that it is a relatively consistent measure across commodities and across countries.

Table 1--Regression results

Dependent variable	$(\Sigma\beta)$	λ
Constant	-120.67	84.92
NAGDP	1.77	-0.78
(t-stat)	(4.03)***	(-2.45)**
CPE	-36.85	-38.22
(t-stat)	(-3.53)***	(-5.05)***
FOOD GRAINS	1.03	-24.60
(t-stat)	(0.07)	(-2.43)**
FEED GRAINS	22.57	-12.44
(t-stat)	(1.41)*	(-1.07)≈
SUGAR	27.43	-11.70
(t-stat)	(1.53)*	(-0.90)≈
MILK	7.33	-32.49
(t-stat)	(0.36)	(-2.22)**
LIVESTOCK	-10.04	-9.91
(t-stat)	(-0.68)	(-0.93)≈
R^2	.29	.22
F statistic	7.45***	4.75***
N (observations)	133	133
Degrees of freedom	125	125

R^2 PSE: .67 R^2 CSE: .21 R^2 (PSE,CSE): .37

*** denotes statistical significance of $p < 0.005$.
** denotes statistical significance of $p < 0.01$.
* denotes statistical significance of $p < 0.1$.
≈ denotes statistical significance of $0.2 > p > 0.1$.

Table 2--Regression results

Dependent variable	(Σß)	λ
Constant	-99.59	95.92
NAGDP	1.40	-0.99
(t-stat)	(3.13)***	(-2.99)**
CPE	-27.82	-33.57
(t-stat)	(-2.63)***	(-4.29)***
FOOD GRAINS	2.62	-23.77
(t-stat)	(0.19)	(-2.38)**
FEED GRAINS	25.24	-11.04
(t-stat)	(1.62)≈	(-0.96)≈
SUGAR	29.62	-10.55
(t-stat)	(1.71)*	(-0.82)≈
MILK	6.37	-32.99
(t-stat)	(0.33)	(-2.29)*
LIVESTOCK	-11.46	-10.65
(t-stat)	(-0.80)	(-1.01)≈
EAST ASIA	38.19	-19.93
(t-stat)	(2.96)***	(2.09)*
R^2	.33	.24
F statistic	7.07***	4.39***
N (observations)	133	133
Degrees of freedom	125	125
R^2 PSE: .83	R^2 CSE: .20	R^2 (PSE,CSE): .41

*** denotes statistical significance of $p < 0.005$.
** denotes statistical significance of $p < 0.01$.
* denotes statistical significance of $p < 0.1$.
≈ denotes statistical significance of $0.2 > p > 0.1$.

Table 3--Regression results

Dependent variable	PSE	CSE
Constant	-129.66	35.99
NAGDP	2.13	-0.91
(t-stat)	(7.77)***	(-1.97)*
CPE	-5.97	-45.74
(t-stat)	(-2.63)***	(-4.22)***
FOOD GRAINS	12.62	-10.91
(t-stat)	(1.52)*	(-0.76)
FEED GRAINS	15.58	--7.58
(t-stat)	(1.60)*	(-0.46)
SUGAR	14.66	-11.37
(t-stat)	(1.35)*	(-0.62)
MILK	18.66	3.03
(t-stat)	(1.50)*	(0.14)
LIVESTOCK	-12.40	-10.92
(t-stat)	(-1.38)*	(0.73)
NET TRADE	-28.45	15.84
(t-stat)	(-4.64)***	(1.54)*
R^2	.32	.23
F statistic	12.68***	4.37***
N (observations)	133	133
Degrees of freedom	124	124

*** denotes statistical significance of $p < 0.005$.
** denotes statistical significance of $p < 0.01$.
* denotes statistical significance of $p < 0.1$.
≈ denotes statistical significance of $0.2 > p > 0.1$.

Table 4--Regression results

Dependent variable	PSE	CSE
Constant	-125.00	27.85
NAGDP	2.02	-0.71
(t-stat)	(6.81)***	(-1.44)*
CPE	-4.49	-43.18
(t-stat)	(-0.68)***	(-3.87)***
FOOD GRAINS	12.84	-11.17
(t-stat)	(1.50)*	(-0.78)
FEED GRAINS	15.95	-8.24
(t-stat)	(1.64)*	(-0.50)
SUGAR	15.95	-12.22
(t-stat)	(1.63)*	(-0.67)
MILK	17.54	4.97
(t-stat)	(1.41)*	(0.23)
LIVESTOCK	-12.92	-11.83
(t-stat)	(-1.43)*	(0.78)
NET TRADE	-25.84	11.32
(t-stat)	(-3.85)***	(1.01)*
EAST ASIA	8.49	-14.73
(t-stat)	(0.96)≈	(-0.99)≈
R^2	.46	.23
F statistic	10.28***	3.72***
N (observations)	133	133
Degrees of freedom	123	123

*** denotes statistical significance of $p < 0.005$.
** denotes statistical significance of $p < 0.01$.
* denotes statistical significance of $p < 0.1$.
≈ denotes statistical significance of $0.2 > p > 0.1$.

Table 5--Comparison of results

Method	Dependent variable		
	PSE	CSE	(PSE, CSE)
		$\underline{R}^2$	
Model	0.67	0.21	0.37
Simple	.32	.23	.27
JTSK Model 1/	.83	.20	.41
JTSK Simple	.46	.23	.32

1/ JTSK includes Japan, Taiwan, and South Korea dummy.

When Do Countries Start to Protect Agriculture?

The estimated model is an implicit function with the variables PSE, net trade (θ), and NAGDP, and binary arguments for regions and commodity groups:

$$0 = F(\mathbf{PSE}, \theta, \mathbf{NAGDP} \mid \text{REGION, COMMODITY}) \qquad [12]$$

By setting the value of PSE equal to zero, a set of iso-protection contours can be plotted in (θ, **NAGDP**) space. Figure 6 plots the following functions:

$$\mathbf{NAGDP} = G(\theta \mid) \qquad [13]$$

$$\mathbf{NAGDP} = G(\theta, \mathbf{CPE} \mid) \qquad [14]$$

$$\mathbf{NAGDP} = G(\theta, \mathbf{EAST\ ASIA} \mid) \qquad [15]$$

The iso-protection contours are the dividing line between subsidizing agricultural production (above the line) and taxing agricultural production (below the line). The curve labeled BASE represents the zero protection line for all non-East Asian and centrally planned economies in the sample. The positive slope of the line indicates that, for the base group, the propensity to protect is positively related to income (NAGDP) and negatively related to net trade. The model predicts, for example, that a nation with a net trade of unity (self-sufficiency) will subsidize its agricultural sector if NAGDP is greater than 82 percent, and tax agriculture if NAGDP is less than 82 percent.

The steeper slope and lower intercept of the EAST ASIA curve indicate a propensity to protect at lower levels of development than the base group. The higher intercept and negative slope of the centrally planned economies curve are consistent with the pro-consumer bias revealed in the SE measurements.[32]

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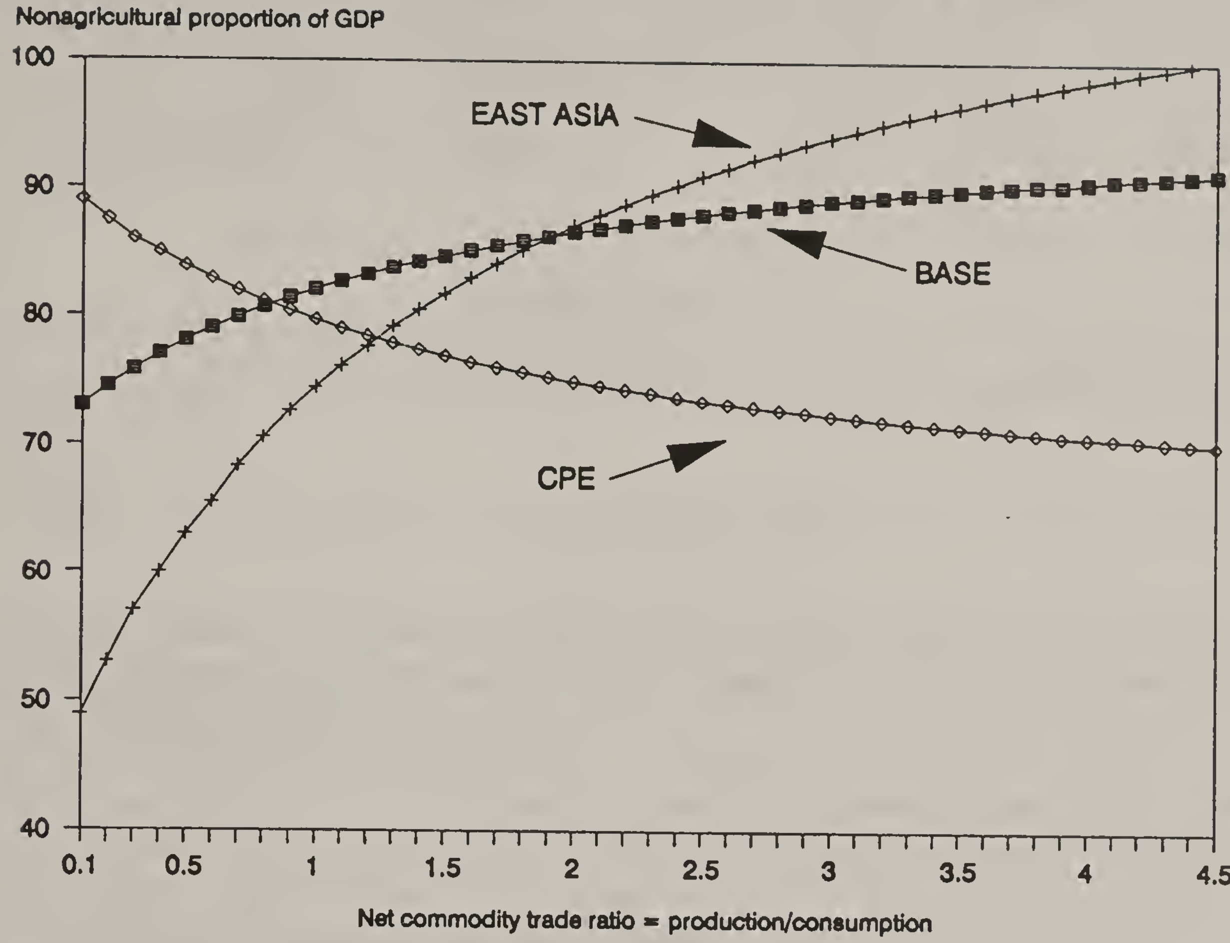
[32] The negative slope may be the result of measurement bias; see the discussion on pages 15-16.

Figure 6
Iso-protection Contours



An important inference may be drawn from the iso-protection curves: countries which are net exporters of agricultural commodities will tend to subsidize their agricultural sectors when the nonagricultural proportion of GDP exceeds 80-85 percent.[33] Countries which are net importers of agricultural commodities will tend to subsidize their agricultural sectors when the nonagricultural proportion of GDP exceeds 75-80 percent. The pattern of protection in East Asia reveals that the onset of protection and subsidization occurs at earlier stages of development.

These iso-protection curves are derived from 1987 cross-sectional data. How well do they perform as a predictor of the onset of agricultural subsidization historically? In the United States, significant subsidization of agriculture did not occur until the end of the First World War. The United States was then, as now, a major agricultural exporter with a net trade value in the neighborhood of 1.4. The corresponding zero protection point for NAGDP is 84 percent. Estimates of U.S. NAGDP for the period 1909-33 are listed in table 6. The estimates are consistent with the predicted value; however, one should note that the slope of the iso-protection line is rather flat for net trade values above 1, so there is a large margin for error. While this example is consistent with the present model, it is intended primarily as an indication of the direction future research on this topic can take, rather than a proof of the model's universal validity.

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[33]Few observations in the sample have net trade values exceeding 2.0.

Table 6--Nonagricultural proportion of U.S. GDP

Study	1909-18	1914-23	1919-28	1924-33
			Percent	
Kuznets (1952)	NA	NA	89.5	91.3
Martin (1939)	82.3	84.8	87.8	NA

NA = Not available.

Conclusions

The bias of agricultural policy is not random. Much of the variation in the degree of subsidization across commodities and countries can be explained by the level of national economic development, net commodity trade, the characteristics of specific commodities, and how these forces affect the incentives of households or producers to organize and influence agricultural policy. A key finding of this study is that there appears to be a tendency for governments to commence subsidizing agriculture once agriculture accounts for less than a fifth of GDP. Net agricultural importers are likely to commence subsidizing agriculture earlier than net agricultural exporters. This dividing line of agricultural protection leaves the OECD countries and a handful of newly industrialized countries (NIC's) on the side of agricultural subsidization, and the LDC's on the side of net agricultural taxation. The cross-sectional nature of this study limits what one can infer about whether the shift to protection demonstrated in this study is universal or whether it is peculiar to common OECD characteristics or to a particular historical era. Clearly, longitudinal or time-series analyses of the relationships explored in this paper are needed to assess the prospects for agricultural subsidization and protection in contemporary LDC's.

That the bias of public policy can be explained by the ability of some economic interest groups to influence policy formation better than others should not be a startling revelation; indeed, it borders on common sense. However, until very recently, economists analyzing agricultural policy have focused more on what policies ought to be, given some agricultural welfare function, rather than examining why existing policies exist and why existing policies have the distributional effects they do. The focus of this study has been to examine the incentives and motivations of the public agents governing agricultural policy as a means of explaining the incidence of existing policies. The results of this study confirm that examining public agents as if they were rational actors is a viable research strategy for explaining observed agricultural policies.

This study has also successfully tested the consistency of the subsidy equivalent (SE) as a measure of government intervention in agriculture. The evidence presented here cannot sustain the claim that the SE is a better indicator than the ERP or NRP for empirical work. Rather, the evidence merely indicates that the SE yields significant results which are consistent with studies employing ERP's and NRP's.

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Appendix: Observations Used in Study

	BA	BV	CO	CT	EG	ML	MK	PL	PO	RI	SG	SY	SU	WH	
Bangladesh										X				X	
Canada[34]	X	X	X		X	X	X	X				X			
China[35]	X	X	X	X	X	X		X		X		X	X	X	
Colombia										X	X	X	X	X	
EC	X	X	X			X	X		X	X			X	X[36]	
India[37]			X	X[38]						X	X	X		X	
Indonesia										X					
Japan	X	X					X	X	X	X			X	X	
Kenya				X						X			X		
Mexico[39]			X								X	X		X	
Nigeria			X							X			X	X	
Pakistan		X		X	X		X	X		X[40]			X	X	
Poland		X			X		X	X	X				X	X	
S. Korea		X	X			X		X	X	X	X		X		X
Taiwan		X	X				X	X		X	X	X	X	X	
Thailand										X					
USA	X	X					X	X		X				X	
USSR[41]		X		X		X	X	X	X	X		X	X	X	
Yugoslavia	X	X	X		X		X		X				X	X	

BA - Barley; BV - Beef and Veal; CO - Corn; CT - Cotton; EG - Eggs; ML - Mutton and Lamb; MK - Milk; PL - Poultry; PO - Pork; RI -Rice; SG - Sorghum; SY - Soybeans; SU - Sugar; WH - Wheat.

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[34] Also, oats.
[35] Also, honey, peanuts, rapeseed, and sesame.
[36] Two observations: durum and "soft" wheat.
[37] Also, rapeseed.
[38] Two observations, long and medium staple.
[39] Also, dried beans.
[40] Two observations, irrigated and rainfed.
[41] Also, coarse grains (aggregate), butter, cheese, and oilseeds (aggregate).

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UNITED STATES DEPARTMENT OF AGRICULTURE
ECONOMIC RESEARCH SERVICE
1301 NEW YORK AVENUE, NW.
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